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Inv.: Detlef AXMACHER
Massimiliano GASPARRO
Dirk NEUBAUER
Frank PACHAN
Lars PFUETZENREUTER
Markus WILKE
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I, Gabriele Fuchs, residing at Amrumer Str. 7, 90425 Nuremberg, Federal Republic of Germany, hereby declare that I am conversant with the English and German languages and that I am a competent translator thereof. I declare further that, to the best of my knowledge and belief, the foregoing is a true, faithful, complete and accurate translation of PCT International Application PCT/DE03/01620 as filed on 20 May 2003 in the name of AFT Atlas Fahrzeugtechnik GmbH, the original of which application has been submitted to me in the German language.

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Gabriele Fuchs

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GEAR WITH TWO TURNTABLES ARRANGED INTO ONE ANOTHER, WHICH ARE INTERCONNECTED VIA A SWASHPLATE

BACKGROUND OF THE INVENTION

Field of the invention

The invention relates to a gear with two turntables arranged into one another, which are interconnected via a swashplate, as it is described for instance in DE 100 38 354 A1.

Description of the related art

A gear, which as a control device for adjusting the angle of rotation of a first turntable relative to the angle of rotation of a second turntable, which are interconnected via a swashplate, is disclosed by generic DE 100 38 354. Here, the first turntable is formed by a camshaft, and the second turntable is formed by an camshaft gear of an internal combustion engine, which gear is connected with a crankshaft.

Here, gear rings with a different number of teeth are formed at the camshaft gear and at the camshaft, with which gear rings a gear ring arranged at the swashplate is engaging. When rotating the swashplate, the different number of teeth of the gear rings effect shifting of the angle of rotation of the camshaft relative to the camshaft gear. This requires very precise manufacturing of the gear rings with high manufacturing accuracy, what, in fact, causes high costs.

SUMMARY OF THE INVENTION

It is an object of the invention to disclose a gear with a swashplate in accordance with patent claim 1, for which the connection between the swashplate and the turntables can be produced in a cost-saving way.

In accordance with the invention this object is achieved by a gear with two turntables arranged into one another, which are interconnected via a swashplate,

wherein the swashplate is connected with the first turntable via at least one pin, and with the second turntable via a gear ring.

In principle, this pin can be formed at the swashplate or at the first turntable. In case of more than one pin they can also be formed at the swashplate and at the turntable. In this case the pin can be produced in one piece with the swashplate or with the first turntable. As an alternative, the pin can be connected with the swashplate or with the first turntable for instance by gluing, welding, force fitting, soldering or screwing in.

The counterpart of the pin for connecting the swashplate and the first turntable is formed by a recess, which is slot-shaped due to the motion of the swashplate.

In a further embodiment of the invention it is provided that the pin and the slot-shaped recess form a sliding pairing, a bushing made of a material capable of sliding being set as a counter bearing onto the pin and/or into the slot-shaped recess. This bushing can be made for instance of teflon, gray iron, brass or bronze.

In particular, when using more than one pin the bushing set as a counter bearing onto the pin and/or into the slot-shaped recess is provided for compensating process tolerances. Thus, bushings with varying wall thickness for setting onto the pin(s) can be provided for assembly of the gear. Accordingly, bushings for setting into the slot-shaped recess can be produced, their slideway for the pin not being formed in the center of the bushing. With accordingly complex built bushings the position of the slideway of a bushing for setting into a slot-shaped recess can be adjusted for instance by screwing.

In a further development of the invention it is provided that for the connection between the swashplate and the two turntables an own lubricant supply is provided, which for instance consists of a nozzle connected with the oil circuit, which nozzle sprays the pin and the gear ring with motor oil when operating the gear.

In a last embodiment of the invention means are provided, such that the first and

the outer turntable are formed as a camshaft gear of an internal combustion engine, which gear is connected with a crankshaft, and that the second and inner turntable is connected with a camshaft of the IC engine, and that the gear is formed for adjusting the angle of rotation of the camshaft relative to the angle of rotation of the crankshaft.

In the following the gear according to the invention with two turntables arranged into one another, which are interconnected via a swashplate will become apparent from the ensuing description of an example of embodiment taken in conjunction with two drawings.

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 shows an axial cross-section through a gear with a swashplate, the first turntable being formed as a camshaft gear, and the second turntable being formed as a component connected with a camshaft,

Fig. 2 shows a cross-section through the gear for depicting the swashplate bearing the pin as well as a gear ring.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The operating mode of a gear with a swashplate for adjusting the angle of rotation of the camshaft relative to the angle of rotation of the crankshaft for affecting the control times of the valve clearance of the charge-cycle valves of an IC-engine is based on the fact that a swashplate arranged on the drive shaft of a control unit comprises an axial bevel relative to this drive shaft and to the camshaft, and thus is rotatably arranged on the drive shaft.

In Fig. 1 a camshaft 4 and a swashplate 2 connecting the camshaft gear 1 is shown in one cross-section, the camshaft gear 1 forming a turntable being connected with the crankshaft of the IC engine via a primary drive designed as a drive chain.

The swashplate 2 comprises a first gear ring 2.1, which engages with a second

gear ring 3.1 of a turntable 3, which is connected with a camshaft 4. Merely the teeth of an angle segment of the first gear ring 2.1 and of the second gear ring 3.1 intermesh by the axial bevel of the swashplate 2. The size of the angle segment, within which the two gear rings 2.1; 3.1 are toothed with each other, depends from the axial bevel of the swashplate 2 relative to the camshaft 4 or to the drive shaft of the control unit which is not shown.

Moreover, the swashplate 2 comprises four pins 2.2, which radially protrude from the outer surface area of the swashplate 2. The swashplate 2 is arranged within a cup-shaped formation of the camshaft gear 1, the four pins 2.2 engaging with four recesses 1.1, which are formed in the cup-shaped formation of the camshaft gear 1. Based on the tumbling rotation of the swashplate 2, the recesses 1.1 of the camshaft gear 1 are shaped like slots. The number of the pins 2.2 as well as the manufacturing of the pins 2.2 depend from the torques, which are transferred from the camshaft gear 1 onto the swashplate 2 via the pins 2.2.

In Fig. 2 four pins 2.2 formed at the swashplate 2 for an IC engine are shown, with high torques being transferred. For guaranteeing high stableness of the pins 2.2, they are produced in one piece with the swashplate 2. With minor occurring loads the pins 2.2 can be applied onto the outer surface area of the swashplate 2 for instance by friction welding.

The swashplate 2 provides for a frictional connection between the camshaft gear 1 and the camshaft 4 extending over the slot-shaped recesses 1.1, the four pins 2.2 and the two gear rings 2.1, 3.1. If the swashplate 2 is not driven by the control unit, this frictional connection causes the camshaft gear 1 and the camshaft 4 to rotate similarly.

For affecting the angle of rotation of the camshaft 4 relative to the angle of rotation of the crankshaft, the first rim gear 2.1 of the swashplate 2 and the second rim gear 3.1 of the turntable 3 have a different number of teeth. This different number of teeth results in an off-set between the camshaft gear 1 and the turntable 3 in case of the tumbling rotation of the swashplate 2. After a tumbling rotation of the swashplate 2 this off-set corresponds to the angle segment, which the teeth forming the difference in the number of teeth are

resuming.

If, for example, the first gear ring 2.1 of the swashplate 2 has fifty teeth, and the second gear ring 3.1 of the turntable 3 has fifty-one teeth, a tumbling rotation of the swashplate 2 results in an off-set between camshaft 4 and camshaft gear 1 of exactly one tooth (= 7.2 degrees). Correspondingly, after fifty tumbling rotations of the swashplate 2 the off-set between camshaft gear 1 and camshaft 4 is a full rotation, i.e. the translation between the camshaft gear 1 and the camshaft 4 is 50:1.

For reducing the friction resistances bushings made of teflon, which are not shown, can be arranged in the slot-shaped recesses 1.1, in which tracks of the bushings the pins 2.2 of the swashplate 2 oscillate during the tumbling rotation.

These bushings may further be used for compensating process tolerances, by providing different bushings for assembly of the gear, the tracks of the bushings being formed centrically and excentrically. If there is an off-set between the pins 2.2 of the swashplate 2 and a slot-shaped recess 1.1 of the camshaft gear 1, this off-set is compensated by a bushing with an excentrically arranged track.

Due to the friction between the gear rings 2.1, 3.1 having a different number of teeth, a nozzle connected with the oil supply of the IC engine is arranged in the area of the gear, which nozzle sprays the gear rings 2.1, 3.1 and thus the entire gear with motor oil.

On the side of the swashplate 2 opposite to the gear ring 3.1 a control unit is arranged, which is not shown and which drives the swashplate 2, this control unit being preferably embodied as an electro motor, however, it can also be realized by hydraulic systems or by a mechanic drive.

By means of the swashplate 2 connected with the camshaft gear 1 via the pins 2.2 for adjusting the angle of rotation of the camshaft 4 relative to the angle of rotation of the crankshaft, the costs for manufacturing the swashplate 2 and the camshaft gear 1 are reduced, thus providing a stable connection between the camshaft gear 1 and the swashplate 2.